



Physics of wind instruments an overview of studies carried out at LMA

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Physics of wind instruments

an overview of studies carried out at LMA⁽¹⁾



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Team « Sound » - 50 people working on audible sound, including musical instruments

Overall goal of our research

Investigate how the functioning of musical instruments depends on:

- ✓ the control parameters, adjusted by the musician during the play (e.g. blowing pressure, lips characteristics, vocal tract configuration, fingerings)
- ✓ the design parameters, fixed by the instrument maker (e.g. geometry, material)

Various approaches

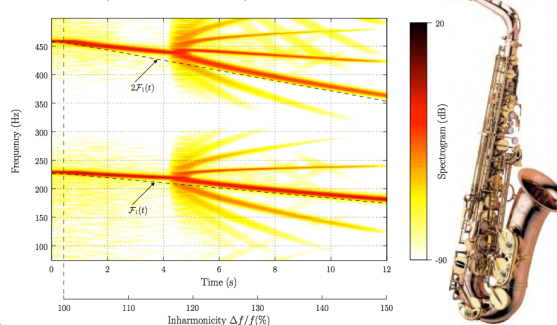
- ✓ In vivo (instrumented instrument) and in vitro measurements (artificial mouth)
- ✓ Real-time sound synthesis
- ✓ Numerical simulation and continuation
- ✓ Analytical developments

Some illustrations of recent works

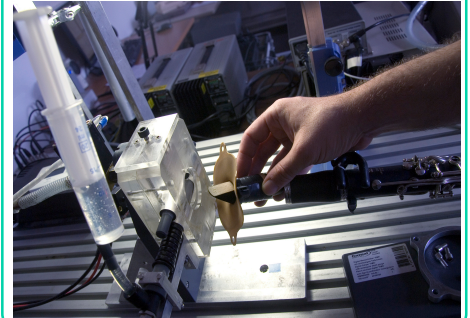
Real-time sound synthesis piloted through MIDI controllers



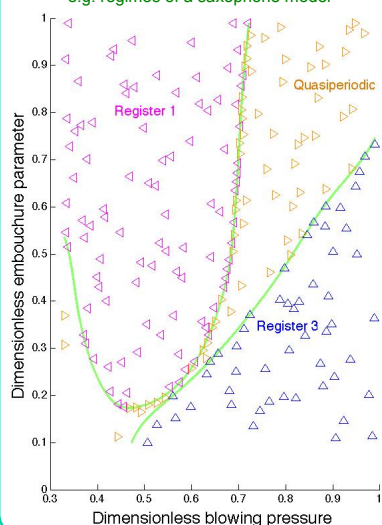
Influence of the inharmonicity of a saxophone on the production of multiphonic sounds⁽¹⁾



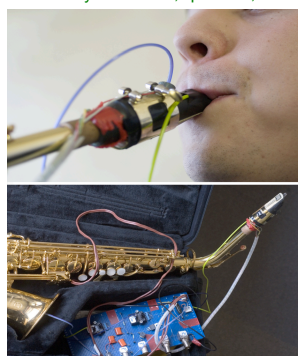
Computer controlled artificial mouth



Adaptive maps of descriptors for numerical models⁽²⁾
e.g. regimes of a saxophone model



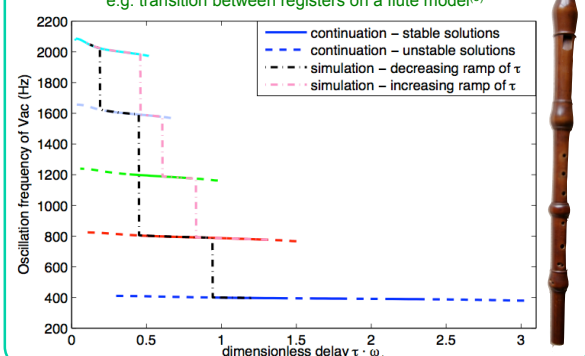
Instrumented saxophone mouthpiece to study vocal tract, lips force, ...



New instruments,
e.g. « logical clarinet »⁽⁴⁾



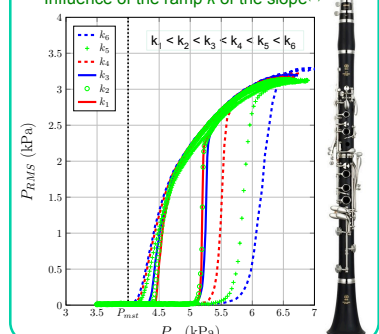
Bifurcation diagrams to reveal many intricate behaviors
e.g. transition between registers on a flute model⁽³⁾



Instrumented trumpet⁽⁵⁾



Attack transients of the clarinet
Influence of the ramp k of the slope⁽⁶⁾



Collaborations

⁽¹⁾ Funded by Labex MEC

⁽²⁾ Collaboration with Samy Missoum, University of Arizona, CODES Lab.

⁽³⁾ Collaboration with Benoit Fabre, IJLRDA, Paris, and David Barton, Univ. of Bristol, England, and Ph. Bolton

⁽⁴⁾ Collaboration with Franck Laloë, LKB, Paris and Daniel Noreland, Umea Univ., Sweden, and ANR CAGIMA (LMA, IRCAM, LSPM, Buffet Group)

⁽⁵⁾ Funded by Labex MEC, collaboration with J.Gilbert, LAUM, Le Mans.

⁽⁶⁾ Collaboration with André Almeida, Baptiste Bergeot, Bruno Gazengel, LAUM, Le Mans.